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It is only to be regretted that this step was not taken earlier, for the large number of idle bulls now in the herd is both a detriment to that body and a positive loss of once good skins. This menace in the growth of the herd has been repeatedly pointed out (Clark, 1914, 1916, 1917; Osgood, Preble, and Parker, 1915) to those having the matter in charge.

The last column in table 1 contains the estimated annual totals for the herd. These numbers are highly artificial in that they are largely made up of computed elements and they are, therefore, so remote from direct observation that their detailed consideration is scarcely worth while. The fact that all elements of the herd have separately increased between 1912 and 1917 is reflected in the increase of these calculated totals from 215,738 in 1912 to 468,692 in 1917.

In conclusion it may be stated that since 1912 the steady increase in the numbers of pups born, and of harem bulls and the decrease since 1913 of the average harem are most favorable signs in the growth of the herd. The one unfavorable feature during this period is the considerable increase in idle bulls in 1915, 1916, and especially in 1917. This increase, which can be eventually checked, shows that active commercial killing should have been restored some years ago.

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THE DESTRUCTION OF TETANUS ANTITOXIN BY CHEMICAL AGENTS

By W. N. Berg and R. A. Kelser

Pathological Division, Bureau of Animal Industry, Washington

Communicated by R. Pearl, April 13, 1918

The ultimate object of this work is a solution of the problem of the chemical nature of antitoxins and their preparation in the pure state. That this would be attained was not expected in view of the numerous previous investigations which left these problems unsolved. But it seemed highly probable that data would be obtained which would throw some light on the subject.

Up to the present time numerous investigators attempted to separate antitoxins from their associated proteins, but without complete success. The well known tetanus and diphtheria antitoxins are examples of preparations containing all or nearly all of the immunity units present in the original serums, but only a part of the proteins. Thus, Homer[1] (p. 400) concentrated a tetanus serum containing 100 units per cubic centimeter and 6% of protein, obtaining an antitoxin that contained 900 units per cubic centimeter and 19% of protein. In this process 10% of the antitoxic units were lost, the antitoxin was nine times as potent as the serum from which it was derived, but it contained only three times as much protein. The failure of all attempts to obtain a protein-free antitoxin preparation has led some investigators to the conclusion that the antibody or group of antibodies which constitutes the antitoxin is one of the serum proteins and hence cannot be completely separated from protein. The concentration of the antitoxin without a similar concentration of protein is regarded by others as an indication that the antitoxin may be a body of non-protein nature.

Under these conditions any test which would conclusively decide whether an antitoxin is or is not identical with a serum protein, would have both a practical and a theoretical interest. The following test was decided upon because of its promising nature. If an antitoxin, tetanus antitoxin, for example, is a substance of non-protein nature, it should be possible to prepare artificial digestion mixtures containing the antitoxic serum or antitoxin derived therefrom, in such fashion that the protein would undergo digestion without loss of antitoxin. Appropriate chemical measurements would indicate the extent of proteolysis, while inoculation experiments on guinea pigs would indicate whether there was any loss of antitoxic units. If, on the other hand, the antitoxin is a protein and its power to immunologically neutralize the corresponding toxin is a function of the intact protein molecule, then the antitoxin would be destroyed in every case where the protein had undergone cleavage, regardless of whether the cleavage was caused by a proteolytic enzyme or other chemical agent. Due regard must of course be had for the possible destruction of the toxin by the chemical agents used.

Several different antitoxic preparations were exposed to the action of trypsin-sodium carbonate solution or to pepsin-hydrochloric acid for comparatively long periods of time, with suitable controls. At proper intervals the extent to which digestion had taken place was measured chemically and compared with the loss of antitoxic units; the latter were determined by guinea pig inoculation as described by Rosenau and Anderson[2]. The results may be summarized as follows:

1. Tetanus antitoxin in 0.5% sodium carbonate solution was slowly and completely destroyed. At the same time no significant chemical changes in the proteins were detected.

2. In solutions amphoteric or faintly acid to litmus strips, trypsin destroys the antitoxin and at the same time the associated proteins are digested. The rates of antitoxin destruction and protein splitting were substantially the same.

From (1) it follows that antitoxin destruction may take place with or without protein splitting.

3. In solutions containing trypsin and 0.5% sodium carbonate the results were the same as in (2).

4. Tetanus antitoxin in 0.2% hydrochloric acid was completely destroyed in three or more days. During this time no significant chemical changes in the proteins were detected.

5. In neutral solutions pepsin did not affect the antitoxin.

6. In pepsin-hydrochloric acid, proteolysis and antitoxin destruction proceeded simultaneously.

These results tend to indicate that tetanus antitoxin is a substance of non-protein nature. But the stability of the antitoxin is so dependent upon that of the protein to which it is attached, that whenever the protein molecule is split, the antitoxin splits with it.

The experimental details are given in the *Journal of Agricultural Research*, 1918.

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[1] Homer, A., *J. Hygiene, London*, **15**, 1916, (388-400).

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TESTS FOR FLUORINE AND TIN IN METEORITES WITH NOTES ON MASKELYNITE AND THE EFFECT OF DRY HEAT ON METEORIC STONES

By George P. Merrill

Department of Geology, United States National Museum, Washington

Communicated by E. W. Morley, April 29, 1918

The following is a partial report on results obtained in continuation of work under a grant from the J. Lawrence Smith Fund of the National Academy of Sciences.

1. On Fluorine in Meteoric Stones.—So far as I am aware the occurrence of fluorine has never been recognized in meteoric stones. Meunier[1] records its presence as doubtful. Fletcher in his Handbook does not mention it at all, nor is it mentioned by Cohen nor by Lockyer in his Meteoritic Hypothesis as one of the elements even recognizable by the spectroscope. Nevertheless, the occurrence of a calcium phosphate has often suggested its possible presence, and the wide distribution of this phosphate in meteoric stones, which I have shown of late[2] seemed to warrant further tests, particularly as new and more refined methods for its detection had been discovered. Opportunity for these tests was recently afforded by Dr. E. T. Wherry when engaged upon the investigation of some fossil bones for Dr. Hrdlička in the Museum laboratories. The method consists in the digestion of the material in concen-